

# NV center – Single Emitter Series

The NV single emitter series features fluorescent diamond containing very low amounts of NV centers per particles. These products are geared toward sensing applications, where the unique spin properties of the NV<sup>-</sup> center are exploited for use in signaling and sensing. Sizes available include 10nm and 40nm particles. Applications areas include, but are not limited to:

- Quantum optics and quantum computing
- Single photon emitter applications
- Neuron firing detection
- Single cell tracking and sensing

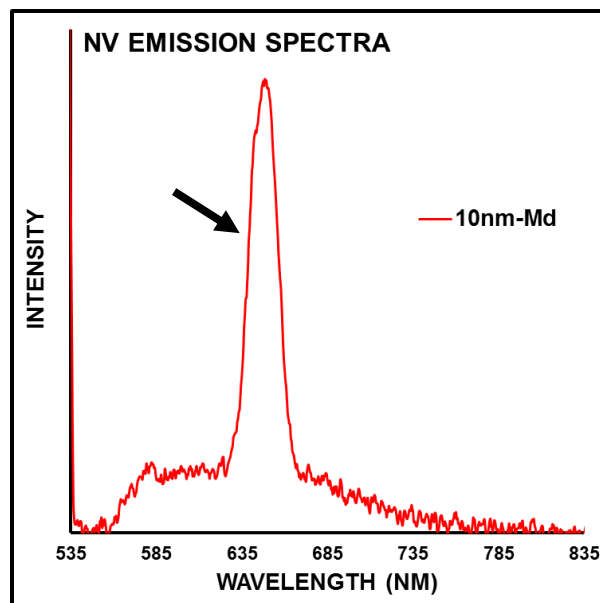
This document will provide general characteristics of the featured product line to help you make a more informed decision before purchasing.

**ULTRASMALL : 10-13nm** 

The level of fluorescence and the population of fluorescent diamond particles in the sub-15nm range is generally very low. These particles are not suitable for direct cellular imaging, but will require users equipped with highly advanced optical setups to use effectively. Therefore, these particles are more suitable for users interested in single emitter applications. The quality of NV<sup>-</sup> centers in these particles is relatively low due to large lattice distortion and damage induced from milling from larger sizes. Single particle fluorescence characterization confirmed the presence of active NV<sup>-</sup> centers, and determined that the approximate NV<sup>-</sup>/NV<sup>0</sup> ratio was ~0.6, so fluorescing particles contain ~60% NV<sup>0</sup> and ~40% NV<sup>-</sup>.

Size (nm)	# NV <sup>-</sup> Emitters per particle	% Fluorescent particles
10	1-2	~6%

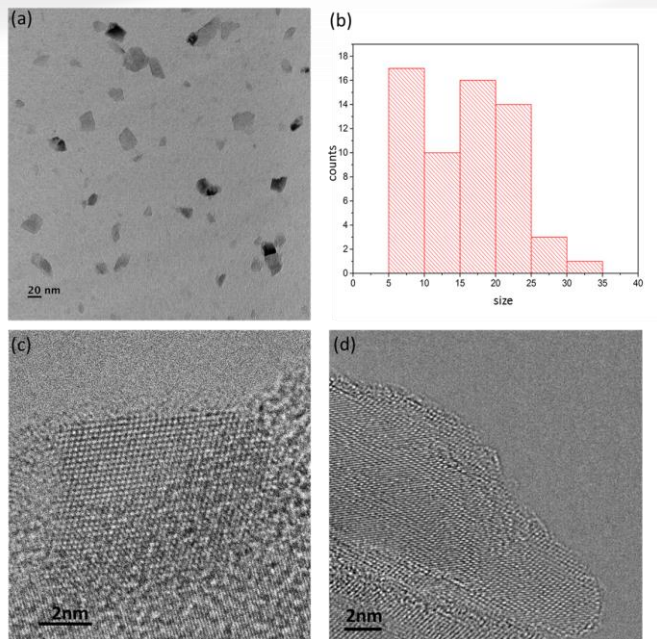
(Above) : Summary of single particle characterization of 10nm-Md particles using AFM-Confocal microscopy setup. Courtesy T. Oeckinghaus, U. Stuttgart.



(Above) : Fluorescent emission spectra for 10nm-Md suspension in DI water at approximately 1mg/mL concentration. 45mW 532nm laser excitation (Coherent Sapphire). Ocean Optics HR2000 spectrometer with 500msec integration time. Water Raman indicated by black arrow.

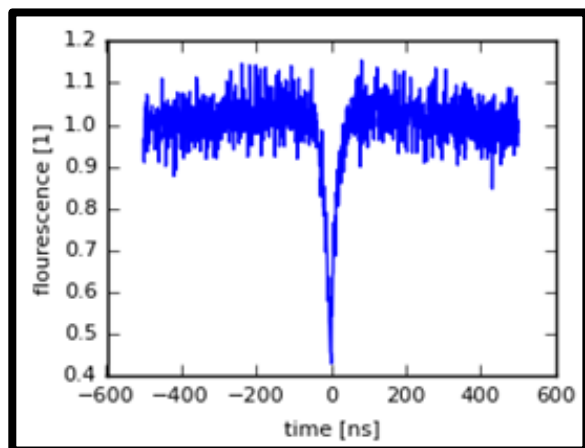
Product	Catalogue No.
10nm - Md	NDNV10nmMd10ml NDNV10nmMd2ml

# NV – Single Emitter Series

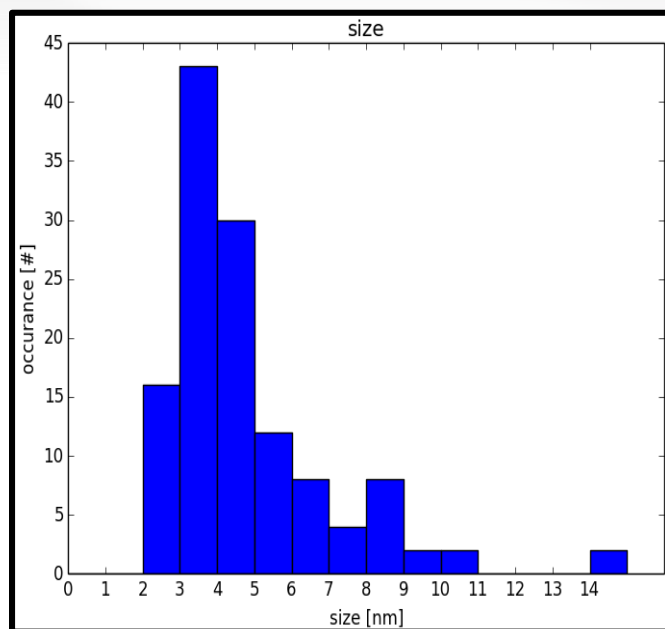


(Above) : High Resolution TEM (HRTEM) images and size distribution of 10nm-Md particles. Courtesy S. Chang, U. Arizona.

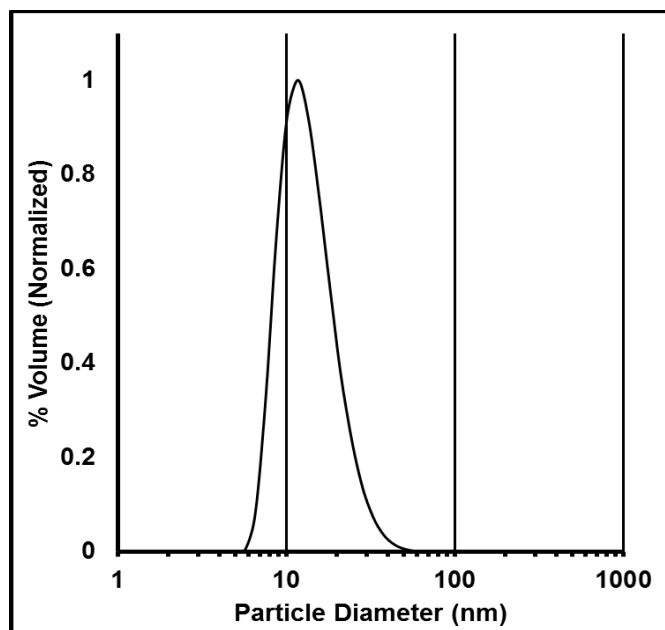
Combined HRTEM, AFM, and DLS confirms the presence of particles 10nm in size and below. Shapes are irregular, with some particles exhibiting flat, elongated shapes. Some particles exhibit an amorphous patches of sp<sup>2</sup> carbon even after extensive oxidation.



(Above) :  $g(2)$  autocorrelation function of 8nm particle exhibiting spin coherence consistent with NV presence. Courtesy T. Oeckinghaus, U. Stuttgart.

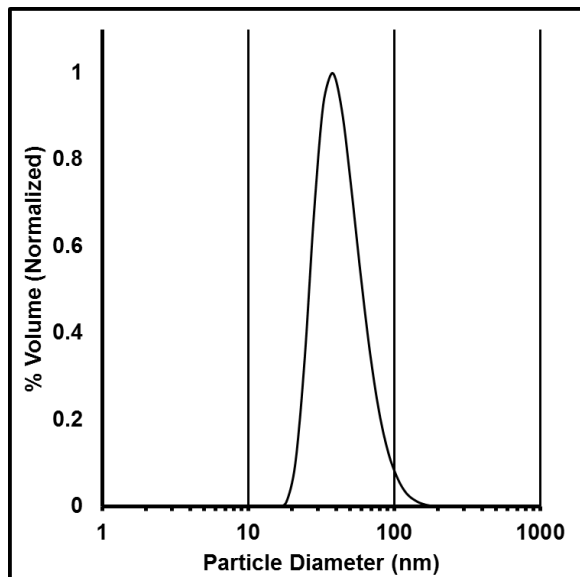


(Above) : AFM confocal size (height) distribution of 10nm-Md particles. Courtesy T. Oeckinghaus, U. Stuttgart.



(Above) : DLS size distribution of 10nm particles in DI water. Measured with Malvern Zetasizer Nano ZS (Malvern Instruments Ltd. UK)

## INTERMEDIATE : 40nm



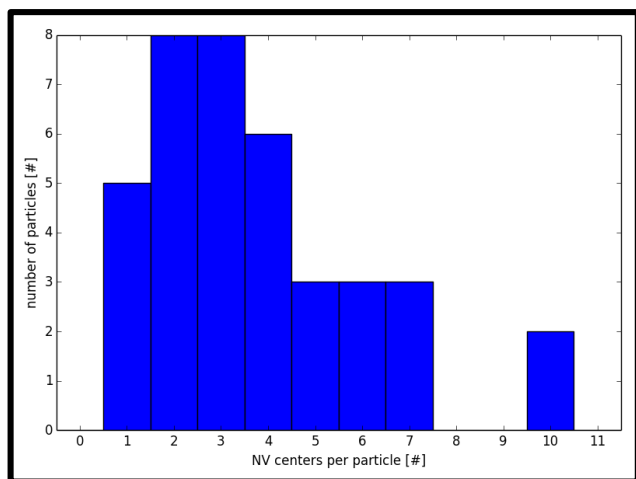
(Above) : DLS size distribution of 40nm particles in DI water. Measured with Malvern Zetasizer Nano ZS (Malvern Instruments Ltd. UK)

The 40nm single emitter series is the most popular product in use for quantum optics research groups. Single particle characterization determined the average number of emitters (NV centers) per particle to range from 1-4 on average. The NV<sup>-</sup>/NV<sup>0</sup> ratio was determined to be ~0.7.

Product	Catalogue No.
40nm-Lw	NDNV40nmLw10ml

Size (nm)	# Emitters per particle	% Fluorescent particles
40	1-4	74%

(Above) : Summary of single particle characterization of 40nm-Lw particles using AFM-Confocal microscopy setup. Courtesy T. Oeckinghaus, U. Stuttgart.



(Above) : Distribution of NV centers per particle for 40nm-Lw as determined from AFM-Confocal single particle characterization. Courtesy T. Oeckinghaus, U. Stuttgart.



**DISCLAIMER:** Product characteristics, specifications, costs, part numbers, and all other details are accurate as of the date of preparation of this document. These values are subject to change. Product characteristics are subject to batch to batch variability and improvements in processing or other developments.

**ACKNOWLEDGEMENT :** Characterization work performed for these products was supported in whole or in part by the National Institutes of Health (NIH) National Heart, Lung, and Blood Institute (NHLBI) under contract No. HHSN268201500010C.

**FEATURED PRODUCTS**

Category	Product	Sold As	Catalogue No.	Price
Ultrasmall Size Range	10nm-Md	1mg/mL Suspension in DI water	NDNV10nmMd2ml	\$200
			NDNV10nmMd10ml	\$570
Intermediate Size Range	40nm-Lw	1mg/mL Suspension in DI water	NDNV40nmLw10ml	\$150